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as of 06-Oct-2017

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STEM Degrees: 0

STEM Participants: 0

Major Goals: We proposed to explore the utility of the theoretical framework of the “resource curse” to investigate the impact of the commodity boom on the Brazilian Military Industrial Scientific Complex. The “resource curse” holds that commodity booms convince politicians and societies that there are no budget constraints, all projects may be funded, and that corruption is of little concern because it does not interfere with distribution of benefits to society at large. This easy wealth undermines sustainable economic growth, political stability and the rule of law. Our study will extend this approach to a new arena (dual use technologies) and a new question (the impact of resource booms and busts on innovation).

Specific to the MISC, commodity booms convince politicians, industrialists, scientists and the military that there is money to increase investments in the MISC without incurring the opposition of politicians and societal groups that perceive a trade-off between investment in MISC and broader social concerns. Proceeding from that starting point, three hypotheses drive the proposed research:

Hypothesis 1. Commodity booms lead to increased budgets in dual use technological R&D

Justification: The perception of an ever-expanding pie means that budgeting priorities give way as budgetary constraints appear to be eliminated.

Hypothesis 2. Commodity boom-fueled investments will generate fewer successful innovations than investments allocated outside of commodity booms

Justification: The selection criteria for a project are loosened as a result of the perception of the arrival of an era of no budget constraints; the boom also encourages political leaders to demand more direct links between investments and national development. In the area of technological innovation, we expect these demands to articulate themselves via increased demands for technology transfer and domestic content.

Hypothesis 3. Collapse of a commodity boom leads to a disproportionately large decrease in dual use technological investments in democratic countries

Justification: Social groups seek to slow the decline in investment in their projects, and the MISC is a relatively weak actor

In this project, we will evaluate these hypotheses using the cases of avionics and nuclear power and focus on how the politics of populism influenced these investment decisions. Specifically, do commodity booms allow them to leap ahead, or are they actually hindered in their technological advances? Will these advances be sustainable or will these projects fall prey to their inefficiencies and political battles during commodity busts?

We will proceed first by identifying the MISC projects funded by the government agencies during three time periods: prior to the commodity boom (1992-2004); during the commodity boom 2004-2014; and post-commodity boom 2014-2016. We will track their budgets and any restrictions regarding domestic content and evaluate their scientific progress and innovation.

Accomplishments: The project has advanced with regard to the empirics of the fighter jets and the nuclear submarine cases but we have not yet completed research on drones, the nuclear-enrichment facility in Resende nor the Multipurpose Reactor. Based on those limited results, we have some initial impressions about the impact of the commodity boom and populist budgeting but we cannot be sure at this point how much the specifics of the civilian avionics sector or the market for nuclear submarine propulsion systems is driving our preliminary results.

The Brazilian Navy's nuclear program, investigated by Diniz, was established in the late 1970s and predates the most recent commodity boom - though the program received a considerable boost during the recent cycle. The Navy's nuclear program led to some technical innovations, particularly regarding the centrifuges for the isotopic separative work used in the uranium enrichment process. But this was begun before the commodity boom, and it did not make Brazil a competitive supplier of enriched uranium for fuel fabrication for nuclear reactors in the global market, at least in the long term, because:

- o the uranium enrichment industry is highly concentrated, and increasingly so, due to significant entry barriers, and particularly economies of scale; and to the deactivation of uranium enrichment plants based on old, gaseous diffusion technologies — particularly those that belonged to USEC (United States Enrichment Corporation);
- o The centrifuge-production industry is also highly-concentrated, with significant entry barriers, again with large economies of scale;

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o Brazilian centrifuges are very energy-inefficient as compared to those used by, say, Areva or Urenco (though energy costs in Brazil are comparatively lower and we'll need to evaluate how those costs are impacted by the commodity boom).

Research into the market also demonstrates that even if we take at face value the Brazilian Navy's claims for its naval nuclear reactor, its performance will be significantly inferior to those from the other naval nuclear reactors currently available, and with larger production costs. Consequently, were a market for nuclear-propelled submarines develop, or at least for nuclear reactors for submarines, Brazil's nuclear submarines would not be price-competitive. We still need to investigate how this likely outcome influenced budgeting for the nuclear submarine during and after the commodity boom.

Waisman's work has focused on the conceptualization of populism, particularly its different variants [north / south, right / left], and on understanding the configuration of circumstances that generate these movements and regimes. The groundwork on populist politics is developing through papers presented by Waisman at a European conference on populism (Trento, Italy, October 2016), the meeting of the Latin American Studies Association (Lima, Peru, April 2017), the meeting of the Council of European Studies (Glasgow, Scotland, July of 2017) and talks at the Academy of Moral and Political Science in Buenos Aires, Argentina, and at several Argentine universities (April-May, 2017).

The aircraft industry, investigated by Altamirano, is a good example of a pocket of innovation in a high technology sector that has been reinforced during the commodity price boom, but it is still relatively small respect to the entire economy. The boom of aircraft related exports are mainly Embraer's exports supported by governmental innovation policies, market forces, Brazilian Air Force policies and Embraer's own business policies.

Three key governmental policies related to industrialization and innovation since 2000 that affected the aircraft industry.

Embraer's two families of E-Jets, the E170 and E190 families, have taken more than 40 % of the world market for regional jets in the category of 60-99 seats since its launch in 1999, and no military applications were derived from them. Success was based on Brazilian technological innovations and the incorporation of strategic partners for new trends in avionics, cockpit and interior designs. The governmental industrial and innovation policies effectively supported the creation of a network of suppliers around Embraer's plants in Sao Paulo, and offered credit lines to foreign clients of the E-jet family.

Before 2010, the Air Force's needs were partially met with dual-technologies that came from the Embraer's ERJ-145 family, the successful jet family in the range of 35 to 50 seats that preceded the E-jet family. Embraer developed three military applications for airborne early warning and control (AEW&C), remote sensing and maritime patrol applications, R99-A, R99-B and P99, respectively. The Brazilian Air Force requested less than 10 units in total, and only 5 units went to Mexico and Greece. So, the dual-technology flow from civilian to military applications was very limited from 1995 to 2009. The two big projects that came from the strategic plans mentioned above are the airlifter KC-390 assigned to Embraer in 2009 and the new generation fighter Gripen NG-E to be developed by Saab and Embraer starting in 2015. The initial Brazilian Air Force request of 26 KC-390 is still in place, the development cost paid by the Air Force is above \$6 billion but it is also shared with other six countries, and the first delivery is estimated to be in 2018. So, there is no detrimental effect for the KC-390 project after the end of the commodity price boom.

Sweden/Saab bid for the FX-2 fighter was based on the offerings of full technology transfer, domestic manufacturing opportunities, export potential and a Swedish 25-year loan at a 2.19% interest rate. Certainly the subsidized credit line compensated any financial problems the Brazilian government could have due to the end of the commodity boom.

In terms of the three hypothesis stated in our initial research proposal, we found the commodity price boom effectively lead the support of civilian aircraft R&D development and the new Embraer E-jet, and only had a minor effect on dual use of R&D for military applications (Hypothesis 1). This limited effect for military applications was not due to the adverse effect of commodity boom-fueled investments with loosened standards and unlimited resources (Hypothesis 2). The limited effect was more because of the minimalistic Air Force's plans before 2009, the commercial regional aircraft demand open to Embraer since 1999, and Embraer's use of governmental industrial policies to consolidate its civilian line of jet production. The Air Force's big plans for dual-technology military applications appear after 2010 and are basically the airlifter KC-390 and new generation fighter FX-2. The

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timing for their development expenditures appear after the commodity boom, and given that both projects are still in progress, we cannot affirm that the collapse of the commodity boom leads to a disproportionately large decrease in dual use technological investments in Brazil (Hypothesis 3). The key elements that explain the continuation of these two projects seem to be in the sharing of costs with other six countries for the KC-390 development and the subsidized credit line from the Swedish government to the Brazilian government to develop the Gripen NG-E fighter.

Training Opportunities: Nothing to Report

Results Dissemination: Carlos Waisman papers presented by Waisman at a European conference on populism (Trento, Italy, October 2016), the meeting of the Latin American Studies Association (Lima, Peru, April 2017), the meeting of the Council of European Studies (Glasgow, Scotland, July of 2017).

Honors and Awards: Nothing to Report

Protocol Activity Status:

Technology Transfer: Nothing to Report

PARTICIPANTS:

Participant Type: Graduate Student (research assistant)

Participant: Tito B. Carvalho

Person Months Worked: 10.00

Funding Support:

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

Participant Type: Graduate Student (research assistant)

Participant: Rodrigo Da Costa Serran

Person Months Worked: 4.00

Funding Support:

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

Participant Type: Undergraduate Student

Participant: Alessandra Ael Da Silva

Person Months Worked: 1.00

Funding Support:

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

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Participant: Antonio De Moura Pereira

Person Months Worked: 4.00

Funding Support:

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

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Participant Type: Other Professional

Participant: Scott W. Desposato

Person Months Worked: 2.00

Funding Support:

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

Participant Type: Graduate Student (research assistant)

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Person Months Worked: 5.00

Funding Support:

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

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Funding Support:

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

Participant Type: PD/PI

Participant: David R. Mares

Person Months Worked: 10.00

Funding Support:

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

Participant Type: Graduate Student (research assistant)

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Person Months Worked: 1.00

Funding Support:

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

Participant Type: Graduate Student (research assistant)

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Person Months Worked: 5.00

Funding Support:

Project Contribution:

International Collaboration:

International Travel:

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National Academy Member: N
Other Collaborators:

Participant Type: Other Professional

Participant: Carlos H. Waisman

Person Months Worked: 1.00

Funding Support:

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

Participant Type: Consultant

Participant: Frank Daniel McCann

Person Months Worked: 1.00

Funding Support:

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

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Funding Support:

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

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Person Months Worked: 1.00

Funding Support:

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

Participant Type: Other Professional

Participant: Nelson Ga Altamirano

Person Months Worked: 7.00

Funding Support:

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

Participant Type: Other (specify)

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Person Months Worked: 11.00

Funding Support:

Project Contribution:

International Collaboration:

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International Travel:
National Academy Member: N
Other Collaborators:

Participant Type: Graduate Student (research assistant)
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Project Contribution:
International Collaboration:
International Travel:
National Academy Member: N
Other Collaborators:

Participant Type: Consultant
Participant: Eugenio Pacelli Lazzarotti Diniz Costa
Person Months Worked: 3.00 **Funding Support:**
Project Contribution:
International Collaboration:
International Travel:
National Academy Member: N
Other Collaborators:

Participant Type: Graduate Student (research assistant)
Participant: Stan N. Oklobdzija
Person Months Worked: 5.00 **Funding Support:**
Project Contribution:
International Collaboration:
International Travel:
National Academy Member: N
Other Collaborators:

BOOKS:

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Publication Identifier Type: ISBN **Publication Identifier:** 978-0-8157-2795-8
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Publication Location: Washington, D.C.
Publisher: The Brookings Institution
Book Title: Aspirational Power Brazil on the Long Road to Global Influence
Authors: David R. Mares, Harold A. Trinkunas
Editor:
Acknowledged Federal Support: Y

CONFERENCE PAPERS:

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Publication Type: Conference Paper or Presentation **Publication Status:** 1-Published
Conference Name: AHILA Conference Proceedings, Berlin, Germany
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Paper Title: Transferencia tecnológica en el largo plazo, aviones, Brasil y Embraer: 1945-20141
Authors: Nelson, Altamirano
Acknowledged Federal Support: **Y**

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Conference Location: Belo Horizonte, Brazil
Paper Title: Brazil's National Identity and Foreign Policy: A U.S. Perspective
Authors: Anne L. Clunan
Acknowledged Federal Support: **Y**

Publication Type: Conference Paper or Presentation **Publication Status:** 3-Accepted
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Date Received: 22-Aug-2016 Conference Date: 02-Jul-2016 Date Published: 22-Aug-2016
Conference Location: Portland, Oregon
Paper Title: The Brazilian Aircraft Industry: Links of Military and Civilian Technology Transfer
Authors: Nelson Altamirano
Acknowledged Federal Support: **Y**

Nothing to report in the uploaded pdf (see accomplishments).